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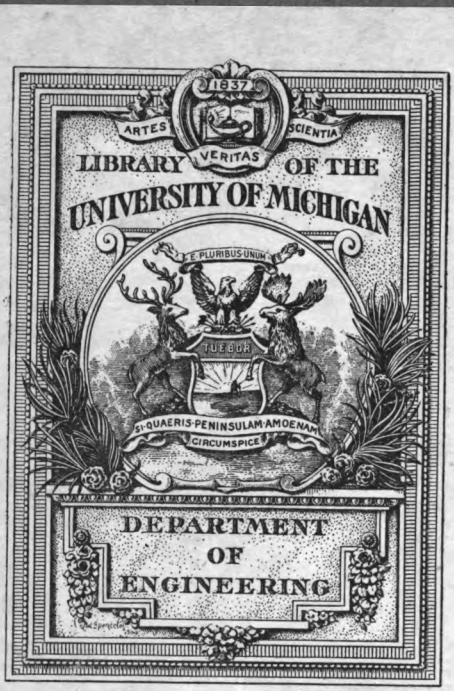

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INTERNATIONAL CONFERENCE OF EUROPEAN TELEPHONE AND TELEGRAPH ADMINISTRATIONS HELD AT THE SORBONNE, PARIS, SEPT. 4th TO 11th, 1910.

TELEPHONE SERVICE IN AMERICA

By JOHN J. CARTY, CHIEF ENGINEER
AMERICAN TELEPHONE & TELEGRAPH COMPANY

SMITH, JONES & LEIGH, NEW YORK

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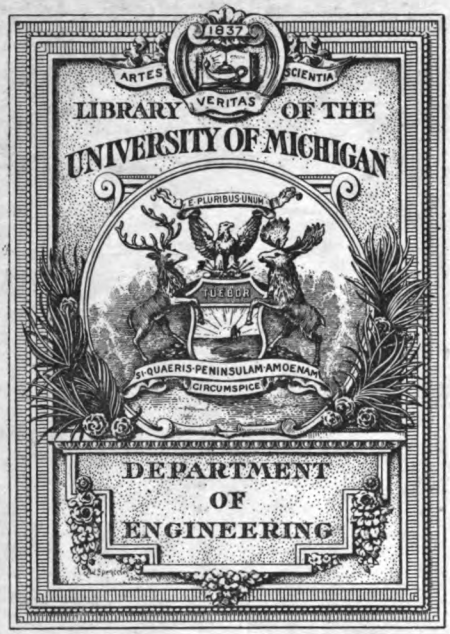

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INTERNATIONAL CONFERENCE OF [redacted]
TELEPHONE AND TELEGRAPH [redacted]
HELD AT THE SORBONNE, PARIS, [redacted]
1910.

TELEPHONE [redacted]
IN AMER[redacted]

By JOHN J. CART[redacted]
AMERICAN TELEPHONE [redacted]

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In the discussion on Automatic vs. Manual Switchboards at the International Conference of European Telephone and Telegraph Administrations at The Sorbonne, Paris, September 4th to 11th, 1910, Mr. Carty said:

Mr. President and Gentlemen:

In response to your request I shall speak upon the question under debate. I will tell of conditions in America, with which I am personally familiar, and regarding which I have accumulated data covering a period of years. I do not presume to speak concerning conditions in Europe, so that I shall be obliged if you will regard what I have to say in this light. From your own expert knowledge of conditions in Europe, each of you will be able to judge how far the experience which we have obtained in America may be applicable to your own case.

The subject under discussion is sometimes stated as "The Manual Switchboard System versus the Automatic Switchboard System." It will be instructive to see what is meant by these two terms.

The term Manual Switchboard denotes a system whereby the operation of connecting two subscribers together is performed by hand, and without the employment of automatic machinery.

The term Automatic Switchboard, on the contrary, denotes a system whereby the two subscribers are connected together by automatic machinery and without the employment of manual labour.

I shall ask you to consider with me for a few moments these two systems.

Let us begin with the so-called Manual Switchboard and make a brief analysis of its method of operation, and by so doing we shall find that it abounds in automatic features and that in its operation automatic labour-saving machinery has been employed to an extent which is truly surprising to anyone who makes the analysis for the first

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time. You will find that the term Manual does not correctly describe the system to which it is applied, and that the so-called Manual Switchboard System is partly Manual and partly Automatic, and you will find that the number of automatic operations which take place in making a connection form a large proportion of the total.

It would consume too much of your time if I should describe in detail each of these operations which is performed automatically and each which is performed manually. I shall give a brief outline of them, and when once your attention has been drawn to this phase of the case, you will have no difficulty in making the complete analysis at your own convenience.

The subscriber desiring to make a call first takes the telephone from its hook and places it to his ear. This is a manual act, but one which is necessary in every system. Removing the telephone automatically releases the hook which flies into contact with several springs, the result of which is to set in motion a train of automatic apparatus closing the subscriber's circuit at the substation thereby automatically actuating a relay at the central office. This relay having been automatically set in operation lights a lamp before the operator, who thereupon performs a manual act, inserting the plug into the answering spring jack. This again automatically makes connections, which accomplish a number of different operations, such as disconnecting the line relay, and so forth. The operator works her listening key and connects to the called-for subscriber. This causes a train of automatic operations to take place, and then the subscriber's bell is rung. He takes the telephone from the hook, and this automatically notifies the operator that he is at the telephone.

The reverse of all this takes place when the disconnection is made. The subscribers hanging the telephones on their respective hooks, thus set in motion a complex train of automatic operations, whereby the operator,

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without listening in upon the line or asking the subscribers if they are done talking, may determine at a glance that the conversation is finished, and by the simple operation of withdrawing the plugs and allowing them to fall automatically into their positions, mechanism is released which automatically restores the lines to their original condition.

In the handling of trunk calls, i. e., calls between the "A" operator and "B" operator in the different offices, another extended series of automatic operations are intermingled with those which are performed manually. In fact, a complete analysis of all the operations involved will show that a very large proportion of them are performed automatically. Thus, it will be seen that notwithstanding what may be said by the partisans of the so-called Manual system, they have, by their deeds, acknowledged that there are many advantages in automatic machinery; in fact, if we trace the evolution of the Manual switchboard as exemplified in the modern Common Battery system, we shall find that its progress towards the present high state of efficiency is marked by the adoption of machinery to perform operations which, in the earlier systems, were done by hand.

In the old type of Manual systems, it was necessary for the subscriber, in order to signal the office, to turn a crank, thus operating the magneto generator and throwing a drop at the central office. At first it was necessary for the operator to restore this drop by hand. Then a plan of automatically restoring the drop upon the insertion of the plug by the operator was adopted. Finally, the drop itself was removed and relays automatically controlled by the subscriber and bringing into play at the proper time electric lights, were substituted.

A study of the growth from the earliest systems to that at present in use shows in a very interesting way that the high efficiency now obtained from the Common Battery System is largely due to the adoption of autom-

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atic operations. As it will be easy for anyone to make this analysis for himself, I will not pursue it further, but enough has been said to make it clear that the so-called Manual system is really one composed of both Manual and Automatic operations. It is partly manual and partly automatic. It is, indeed, a form of semi-automatic.

Turning now to the so-called Automatic System and making but a brief analysis of its operation, we find that properly speaking, it is not an automatic system, but only partly so, and that without the aid of human intelligence at the central office and without the employment of operators, it has not been possible to operate it on any substantial practical scale. While this is true even in a telephonic network with a single central office, the full force of the statement is not appreciated until we contemplate the so-called Automatic System as being applied to a comprehensive telephone system, such as sooner or later must grow up in every country and in every city.

Let us consider the operations of the Automatic System in the elementary case of a single central office. The subscriber desiring to send a call must take his telephone from the hook and perform a number of manual operations, depending upon the character of the call he wishes to send. Then he must press a button, which if all goes well, rings the subscriber desired.

It has been found in practice, however, that this automatic machinery at the central office can be made to give service only by the aid of mechanicians constantly in attendance there. The duty of these mechanicians is not simply to make repairs and remove faults in the ordinary sense of the term, for they do more than this. They actually assist the machinery to work. By the most careful training, some of them become exceedingly expert, so that with a supersensitive ear, they are able to detect when the machinery is going wrong. They are equipped with portable telephones and transmitters, and when

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they have reason to suspect that the call is not going right, they listen in upon the subscriber's line, and if the machinery has gone wrong, they ascertain from him the number desired and operate the machinery by hand, so as to produce the desired connection.

The assistance which they give requires them to listen frequently to the conversation of the subscribers and to give constant surveillance to the connections. This supervision is as varied as the character of the faults encountered.

These men, whose presence is essential to the working of the system, are, in fact, "Mechanician Operators." In addition to these, operators must be employed for toll and long distance work, for answering subscribers who call for numbers which have been changed, and for performing those large classes of service requiring human intelligence.

In America, wherever you go into an automatic exchange, so-called, there you will find operators employed for these various classes of service which I have mentioned, and for more which I might give in detail if time permitted. In all of these exchanges comfortable operators' quarters are to be found, together with the usual provisions of lavatories, retiring rooms and other conveniences which are to be found in the so-called Manual exchanges.

But it is not in the system in its undeveloped state employing only one central office that the Manual features of the Automatic system are to be most clearly discerned. In order to see how thoroughly misleading is the term Automatic Switchboard as applied to these systems, it is necessary to contemplate a telephone system more or less highly developed.

To do this we must consider the telephone system as a whole, taking into account all of the circumstances of the case, not simply one, or two, or three of them, but the whole multitude of factors which enter into such a com-

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plex problem.

We must give rigorous attention to a vast amount of data and requirements pertaining to the traffic upon which the design of the system is based, and we must take carefully into account all of those important commercial circumstances which have such a profound, though often unsuspected effect in broadly shaping the results.

It is only after we have done all of these things that we are prepared to begin to design the plant of the Telephone Company or Administration. This word Plant, which in the English language is applied to the structure constituting the physical property of the Telephone Company, is happily suggestive in connection with the point I wish to illustrate, for it brings to mind the idea of growth, and that in a problem such as ours, in order to attain successful results, we must contemplate a plant or system as it must exist at its different stages of development. We are not building something which, as it leaves our hands to-day, is in its final form. Each day, each month, each year, our plant is growing and we must so shape it, and so add to it, that as this growth proceeds it will have the highest efficiency which may be expected of it at each period of time. And above all, we must take care that the principles upon which this growth is planned will be such that when the system is fully developed, it will be working at its highest efficiency.

Our view is not comprehensive if it is confined to the central office switchboard alone. We must always have in mind, that while this is a vital part of the system, it is by no means all, and that considering the telephone investment as a whole, the money invested in central office switchboards is a relatively small part of the total.

In our American practice we have for years endeavoured, and I may say with substantial success, to take this view of the situation. In my office there is a large sub-department devoted to the study of the question from

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the standpoint of subways and cables; another for buildings; another for all telephone apparatus, including central office switchboards; another and very large department working upon the traffic parts of the problem; one devoted to development studies relating to growth of population and stations and kindred subjects; and still another whose sole duty it is to make fundamental plans based upon all of these data put together and co-ordinated.

These fundamental plans being based upon all of the factors in the case provide in outline for the location and number of the underground ducts and cables, the location and size of the central offices, and the size of the central office switchboards.

It is obvious that if to serve the needs of a given locality, it is necessary at the present time to put underground a single duct, it would be a mistake to limit our construction to the immediate needs of to-day, provided, as is nearly always the case, further growth is to be expected. Some provision for the future must be made. How many ducts, therefore, we should put down in advance of the immediate needs is a very important engineering and economic problem. If but one duct is put down now, and another one is needed the following year, manifestly a waste of money will be incurred, due to removing the pavements and making a new excavation the following year. To provide for the future, therefore, by adding duct by duct and digging up the streets each time a new duct is needed, would cause a great waste of money.

On the other hand, to take an extreme case, if a sufficient number of ducts were put down to provide for the needs of 100 years in the future (even assuming we could forecast correctly for such a long period), another waste of money would take place, for the interest and other annual charges upon the construction which must remain unproductive for so many years would more than

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offset the saving which would be made by avoiding the repeated excavations.

We must choose, therefore, in our construction, some point between these two extremes.

In the plans which we have made for New York and for the other Cities in America, it has been found, all things considered, most economical when building new subways to plan for a period somewhere between 15 and 20 years ahead. Such considerations as these have guided us in making fundamental plans for New York City, which so far as buildings and subways are concerned, are intended to form a general guide for our construction work which is to take place each year for the next 20 years. These plans are not speculative or paper plans, but we express our confidence in them by following them in the construction which we do each year, putting down not only that which is needed for to-day, but that which after most careful studies, represents our best judgment of what will be required during a period of 20 years.

It should not be understood, however, that we can forecast with precision the requirements for so long a period ahead, but we have worked with these fundamental plans now for so many years that we know that they form a trustworthy guide, provided that they are continually kept under review and modified each year as the exigencies of growth demand.

If it would not take me too far away from the subject under debate, I could show to you in many interesting ways the vast sums of money which we have saved because of these fundamental plans and how absolutely essential they are in enabling us to expend most economically the enormous sums of money which we annually put into our plant. For example, our expenditure for new construction during the first six months of 1910 is more than $21,000,000.

With such plans before us for a given city, we are able to study the probable conditions of the plant at

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each period of its growth, and with such a guide we are deterred from installing a switchboard or other system, however suitable it might seem to be at the moment, that would not be capable of growing into that form and to that magnitude which would be required of it by the conditions which it must encounter before its life has expired.

Some idea of these conditions at New York so far as they are affected by magnitude may be obtained from the following data. The fundamental plans for that city, not including the vast suburban region outside of the municipal limits of Greater New York, provided in 1900 for a system of 51,398 telephone stations, served from 43 central offices, the population of the city being 3,437,000. In 1910 the plans provide for 376,000 stations, served from 52 central offices with an estimated population of 4,800,000. In 1930 the plans provide for 2,142,000 stations to be served from 109 central offices, with an estimated population of 8,800,000.

Without any commentary whatever these figures at once put us on our guard against the grave danger of assuming, even if the so-called automatic system was suitable for a small number of subscribers, that it would be a proper thing to employ in New York or any other city where it is expected that a proper development of the telephone will take place. This feeling of caution is strengthened when we consider that in the neighborhood of New York City, there is a vast suburban region intimately connected with it telephonically and served by a very great number of central offices connected by a plexus of trunk lines. But there is more than this which we must take into account when we are studying this automatic system as applied to America. It is the grand ideal of Mr. Theodore N. Vail, the founder of the Telephone enterprise in America and still its active head, that we shall provide Universal Service. That is, that each person, firm or company in the United States that ought to have a telephone shall be provided with one, and that

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any person so provided wherever he may be located, can within a reasonable time be connected to the telephone of any other subscriber and talk satisfactorily.

This is not a mere dream. We have done solid continuous work upon it for more than thirty years and now with rapid strides it is proceeding to fulfilment. At the present time an enormous amount of toll line business takes place between New York City and the territory tributary to it for 30 miles around. In 90% of this business the connection is made in an average of 38 seconds, and in the remaining 10% the average is about 80 seconds. In all of these cases the transmission conditions are so planned that the subscriber may converse with ease. A local call is accomplished in less time, requiring only 22 seconds where but one office is involved, and slightly more between two offices.

These figures which I have given include the elapsed time from the receipt at the central office of the subscriber's signal on the lamp until he is connected with and is talking to the called-for subscriber. But to establish a universal service requires working over much greater distances than this.

We already have an effective long-distance service through underground cables of the Pupin type from New York to Philadelphia (90 miles) and good talking with prompt connections is an every day matter between New York and Boston (235 miles). Our long distance wires extend to Chicago and other more distant western cities, and to Washington, Baltimore, Atlanta and other places in the far south. At the present time we are extending an underground cable of the Pupin type from New York to Washington (235 miles) and are making surveys and plans for an extension from New York to Boston. More than this, by the adoption of phantom loaded overhead circuits between New York and Chicago, and by similar extensions westward as far as Omaha and thence to the Rocky Mountains, we expect by the first of January next

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to have so greatly extended our "Long Distance" frontier that conversation may be held between Denver, Colo., and New York City, a distance of 2,200 miles.

I have mentioned these things to give a suggestion of the intricacy and magnitude of the system for which switchboards must be provided and to bring out strongly the point of view from which we must judge the capabilities of this so-called automatic system. Our problem is national, not parochial—it is indeed even international as your presence here today so eloquently testifies.

We must provide for the public a comprehensive system of which switchboards form only a part; and which shall be suitable not only for to-day, and for this year and for the next, but which shall be at its best obtainable efficiency during each period of its entire life. These things we must do if we are to avoid stupendous blunders and enormous reconstruction costs.

We must regard our growing plant as the landscape architect views the subject matter with which he works. He must plant his trees and shrubs not with a view to the immediate results, but he must have in mind the space which will be occupied, and the shape and character of his plantation as it grows to maturity. He must leave room for his trees to grow and must have in his mind at the beginning the total effect which he desires to produce. So it is with us. We must not install a system because of its fancied immediate attractiveness, if we can discern, by looking into the future, that its growth must be stunted and that it cannot survive the cold winters of practice. We are planning a magnificent park with its groves of trees and shrubs. We are not raising vegetables. We are planting avenues of oaks, not a bed of mushrooms.

It is with such thoughts as these that we have studied the question of different types of switchboards in America, and when thus considered, it is surprising to see how many of the features of the so-called automatic system fail

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to apply to the conditions of practice. Among these conditions with us is the necessity of providing private branch exchange service. This is done by locating at the subscriber's premises a switchboard provided with trunk lines extending to the central office and with a number of stations, sometimes a very large number, located in different parts of the subscriber's premises and connected with the P. B. Ex. Some of these private branch exchanges have as many as 1,200 stations connected with them. This number, however, is exceptional.

By means of this private branch exchange system a most satisfactory method of giving local connections throughout the different parts of the subscriber's premises is provided and from any of these stations by means of trunk lines to the central office, connection can be had to any other station in the entire telephone sytem, whether it be reached by local, suburban or long-distance trunk lines.

Notwithstanding the work that has been done and all the claims that have been made, no practical way has been discovered for doing away with the operators at these private branch exchanges, and the outlook for a practical solution meeting all of the plant, traffic and commercial requirements is so discouraging that at the present time the best opinion is that nothing but failure in this respect is to be expected. It should not be understood that at each of these P. B. Ex. switchboards, there is an operator solely devoted to handling telephone calls. While this is the case in the larger installations, in the smaller ones, of which there is a very large number, the switchboard is operated by a clerk or someone who has also other duties to perform.

This P. B. Ex. development forms one of the most satisfactory and important features of the telephone in America. Some idea of its popularity and the magnitude which it has attained and is expected to attain will be gathered from the following figures. In 1900, New York

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City had a total of 1,050 P. B. Ex. switchboards, located at subscribers' premises and serving 12,650 stations, connected with them. In 1910, there are 11,960 P. B. Ex. switchboards, to which there are connected 162,560 stations. In 1930, as a result of our studies of this subject, we are planning for 88,400 P. B. Ex. switchboards, having connected with them a total of 1,079,000 stations. These figures have a deep significance. They show that in the carrying out of plans upon which construction work is now being done, that we shall reach a point where more than half of the stations connected with the New York City system would require to be handled by operators, even if automatic switchboards were installed at the central office. But more operators than these would be required in an automatic system applied to New York. Large numbers of toll operators and of long distance operators and monitor operators and operators for many other classes of service would be needed.

I have not before me a computation as to the total number which would be required in the system which we are planning, but some years ago a careful study was made with a view to seeing how far the automatic system might be advantageously used in New York City at that time. It was then found that counting P. B. Ex. operators and the central office operators, the so-called Manual system would require 13,000 operators, and that in the so-called automatic system, leaving out of account the "Mechanician Operators," there would be required 10,000 operators.

We have studied this automatic system, not only in connection with its application to large cities, but also when applied to an entire State. For this purpose a thorough study was made of the telephone system of the State of Connecticut. This study was made by a large staff of most competent engineers and consumed several months in the making. The result of this was to show that at the time the study was made, if we counted all of the private

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branch and other operators needed with the Manual system, there was a total of 892 required. A similar careful study showed that if the Automatic system were installed 600 operators would be needed, not counting the "Mechanician Operators."

All these things show that the Automatic system, which has so many alluring features about it when its application to simple conditions is considered, becomes more and more unsuitable as the plant grows. Even when the automatic system is applied to the simple case of a single office district we have yet to find an instance in which the total annual charges lying against it are less than the Manual.

I am aware that statements have been made by the partisans of the automatic system purporting to show that the annual charges on that system are much lower than on the Manual. We have analysed the conditions of these cases and found the comparison was not made upon a fair basis. Where these Automatic systems have been installed, they have taken the place of obsolete or inefficient Manual systems and the comparison has been made between an Automatic switchboard of the most efficient type known and a Manual switchboard of a very defective type. In some cases the comparison has been made between the best type of automatic and the very poorest known type of Manual switchboard. It is not surprising, therefore, that from such comparisons, figures could be obtained which would appear to favour the automatic. We have been at great pains and expense to make these comparisons on a proper basis and in a thorough and fair manner.

We have made studies in a number of cities in America, taking into account the factors of operating maintenance, depreciation, taxes, insurance and so forth. In every case we found that the annual charges were in favour of the so-called Manual system.

I think enough has been said to show that the Automa-

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tic system properly considered, does not do away with operators, does not operate without the constant surveillance of skilled mechanicians, and that it is in truth not an Automatic system at all, but merely one form of Semi-Automatic system, of which the so-called Manual is another.

By such considerations as these we are led to a point from which we can approach our subject with a mind freed from bias. By so doing we clearly see that we have not to do with a partisan controversy about Manual Switchboards versus Automatic Switchboards. We have before us a broad question in telephone engineering, requiring for its solution a clear apprehension of a host of subjects pertaining to the plant, traffic and commercial activities of the Company or Administration. It is a grave mistake to regard our problem as being one for the mechanician only. It is much broader and deeper than this, involving important questions of political economy.

Having stripped our question of its verbal disguise, we see that the two systems are not so antagonistic as would at first appear. They both stand upon this common ground: Each recognizes the importance of manual operations guided by human intelligence; each recognizes the importance of automatic machinery; each system employs both agencies; each system is semi-automatic.

We are now prepared to formulate the question anew. We see that it becomes a problem of dividing the total operations to be performed, in such a manner that labour guided by human intelligence shall be employed where it is most effective, and that automatic machinery shall be employed where it is most effective. Properly stated, therefore, our question is "What is the best type of Semi-automatic switchboard?

The so-called Automatic system, as I have shown, is found unsuitable for the demands of a comprehensive system. The so-called Manual system has been tested by

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the most severe demands of a system composed of 5,000,000 telephones, and it has been found to answer every substantial requirement. By its means we are to-day giving an excellent service and our studies of the future requirements show that if nothing better is attainable, we can, with the Manual system, supply in a satisfactory manner all the demands of the public.

But it would not do for us to rest content with this. We must at all times strive for improvements. These are the traditions of the American Telephone and Telegraph Company, added to which are the specific orders from President Vail frequently reiterated, that we must constantly seek for improvements so that we may at all times when it is reasonable and practicable, place at the disposal of the public that system which solid experience has demonstrated to be the best.

Pursuant to this policy we have spent hundreds of thousands of dollars in experiments and investigations pertaining to this subject.

We have, after many years of work, developed and are now installing at New York for an experimental demonstration, a system which is avowedly semi-automatic and not disguised under another name. The advocates of this system contend that it is a mistake to place, as is done in the so-called automatic systems, complicated automatic machinery at each sub-station. (A sub-station is any telephone set at the subscriber's premises which may be connected to the central office). They favor the use of a sub-station instrument identical with that employed in the so-called Manual, and they assert that this instrument is really much more automatic than the instrument employed in the so-called automatic system itself.

We must admit that there is much force in this statement, for an analysis of the operation of the two instruments shows that the manual operations required at the automatic station are several times more numerous than

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at the manual station. In fact all of the manual operations required at the manual station are also required at the automatic station. To these must be added at the automatic station a number of other manual acts, depending upon the character of the call to be sent.

It is further asserted that the apparatus at the automatic sub-station is complicated to a high degree, whereas at the Manual station it consists of simple elements, and that in consequence of this, with the vast multiplication of stations which must take place in a successful telephone system, the automatic system would be placed at a great disadvantage.

In this semi-automatic system about which I am now talking, a counterpart of the automatic apparatus which is required at each subscriber's station in the automatic system, is placed at the central office. Thus one of these pieces of apparatus is required for each "A" operator's position instead of one for each sub-station on the subscriber's premises. This greatly reduces the number of complications, and one of them being required for each operator's position only, much more money is available to be expended upon its construction. Hence it can be made with great precision and so as to give much more reliable working. Furthermore, these pieces of apparatus being at the central office, they are under the constant care of expert maintenance employees, who can instantly substitute a spare apparatus for one which should become defective.

It is contended on behalf of this semi-automatic system that the "A" operator's position (the "A" operator is the one who answers the subscriber in the first instance), is a point at which human intelligence is needed, because of the numerous exigencies of the service. I have carefully looked into this statement, and I am much impressed with the force of the reasons given in support of it. While the position of the "A" operator seems to be one where human intelligence is required, it is not so at the position

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of the "B" operator (the "B" operator is the one who receives the trunk call from an "A" operator at another office). When the work of this "B" operator is analysed it will be found theoretically that it can all be done by machinery and that the work to be performed does not require human intelligence. Consequently, in this semi-automatic system, all of the "B" operators are eliminated and machines substituted. This very greatly reduces the total number of operators required, and if the machinery can be made to work satisfactorily, it is believed that greater precision of working will be attained. This expectation is based upon statistics which show that a large part of the errors made at the central office take place between the "A" operator and the "B" operator.

As the pieces of automatic apparatus needed in the semi-automatic system at the "A" operators' positions in the central office are relatively small in number, it does not seriously increase the total expense to design and construct them with the greatest care and with the best workmanship, so that the utmost degree of precision may be obtained in their working. On account of the enormous number of such pieces of apparatus which would be required if they were distributed at the subscribers' premises, one for each telephone station as is required in the automatic system, the same high degree of design and workmanship cannot be applied, because the costs would be multiplied exceedingly. Hence in respect to these vital parts of the two systems, the automatic system must always stand at a disadvantage.

The result of this has been to produce for the semi-automatic system an apparatus operated by a keyboard similar to that used on the typewriter. Working with such a keyboard, it has been experimentally demonstrated that the "A" operator can handle a very much greater number of calls than she could in the so-called Manual system. This fact greatly reduces even the number of

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"A" operators.

The advocates of this system contend that they have made the best division of labour, the best distribution of automatic machinery, and that they can attain a higher degree of efficiency and much lower annual costs than are attainable with either the so-called Manual system or the so-called Automatic system.

Engaged upon this study and upon these experiments we have had a corps of capable engineers and experimentalists working for years, and I feel warranted in attaching great weight to their favorable expectations.

Soon after my return to America, I hope to be present at the opening of the Semi-automatic switchboard, and until we have obtained the results of this working, there is not much more that I can profitably say upon the details of the subject.

In conclusion, the situation as I view it, is as follows:— The so-called automatic system is not, in fact, automatic, it is only partly so. It has been fairly and exhaustively studied and found to be unsuitable for the comprehensive demands of our present service, and more and more unsuitable when considered with respect to the demands of the future.

The so-called Manual system has successfully withstood the severe demands of a system comprehending 5,000,000 telephones and all of our careful studies with respect to future growth have shown that if nothing better were obtainable, it would furnish to us a means whereby we could supply an excellent universal service to all the people of the United States.

As I have already stated, a third system, frankly called a Semi-automatic system, is about to be practically tried. If the expectations regarding it are realized, it will be a system more efficient and more economical than either the so-called Manual or the so-called Automatic.

Before leaving this subject, I wish to speak briefly upon one point. It has been said by some that we have

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not generally adopted the so-called Automatic system, because we have been deterred by the large expenditure of money which would be required.

I shall promptly show you that there is no truth in this. The history of the telephone in America has been that of rapid change from one system to another, as soon as improvements have been demonstrated. Pursuant to this policy, the plant at New York has been constructed and reconstructed three times. A similar story is to be told of the rest of the country. Our Company has been so conservatively financed and our Administration has been so keen to adopt new improvements, that ample depreciation funds have been accumulated so that just as soon as it is demonstrated that a better switchboard system is available, we are prepared to begin its installation and proceed with the utmost practicable speed to make the change. All of this could be done without the slightest disturbance in our financial arrangements.

While there rests upon us the responsibility of adopting as soon as it is practicable and reasonable to do so that which is best, there is a corresponding and most serious obligation of not throwing away what has been demonstrated to be a thoroughly efficient system, without having it conclusively demonstrated that there is something better. I do not see anything in the present state of affairs which need give any Company or any Administration any concern with respect to the possibilities of a sudden change, for even if it were demonstrated that a better system were now available, it would be impossible, taking into account the manufacturing and engineering resources of all the world, to make the change except in a gradual manner. We have already had so much experience with such changes that we know how they must take place. They are accomplished by a process of gradual evolution and not by sudden revolution.

In every Administration there are from time to time switchboards which have been worked for the full period

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of their life. These must be replaced in any event, and when such cases arise, the new type of switchboard is installed. This does not involve the abandonment of apparatus having further usefulness. There are also constantly arising cases where new installations must be made. These can be installed on the new plan. Obviously, this does not require that any existing apparatus be thrown away. The manufacturers and the Administration staffs would find themselves so fully occupied with this work that they would not for some years be able, even if it were desirable, to disturb those central offices in which the switchboards have many more years of life. It will be found that by the time the old switchboards have been replaced and the new ones installed, those switchboards which have had to be removed in advance of the expiration of their life would be few, and in those cases the work would not be anticipated by a great many years. Even where a switchboard is removed before its life has expired, this need only be done when it is found best, all things considered, to replace it by a new one rather than to continue it in service. There is nothing in this situation which demands a headlong rush, so without wasting any time, we should proceed with deliberate care.

We, who are charged with the great responsibility of rendering such an important service to the Public, cannot be justly criticised if we refuse to be carried away by the enthusiasm of Manufacturers and Inventors and thus to be led into a wholesale and probably disastrous experimentation upon the public.

In America we have pursued this subject for many years with the utmost diligence. An important practical demonstration is about to be made. We cannot foretell the answer, but we must accept it whatever it may be.

I have told some of the things we have done. It has been our constant aim to keep an open mind and to be free from bias. We are seeking only the truth and from that we have nothing to fear.

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